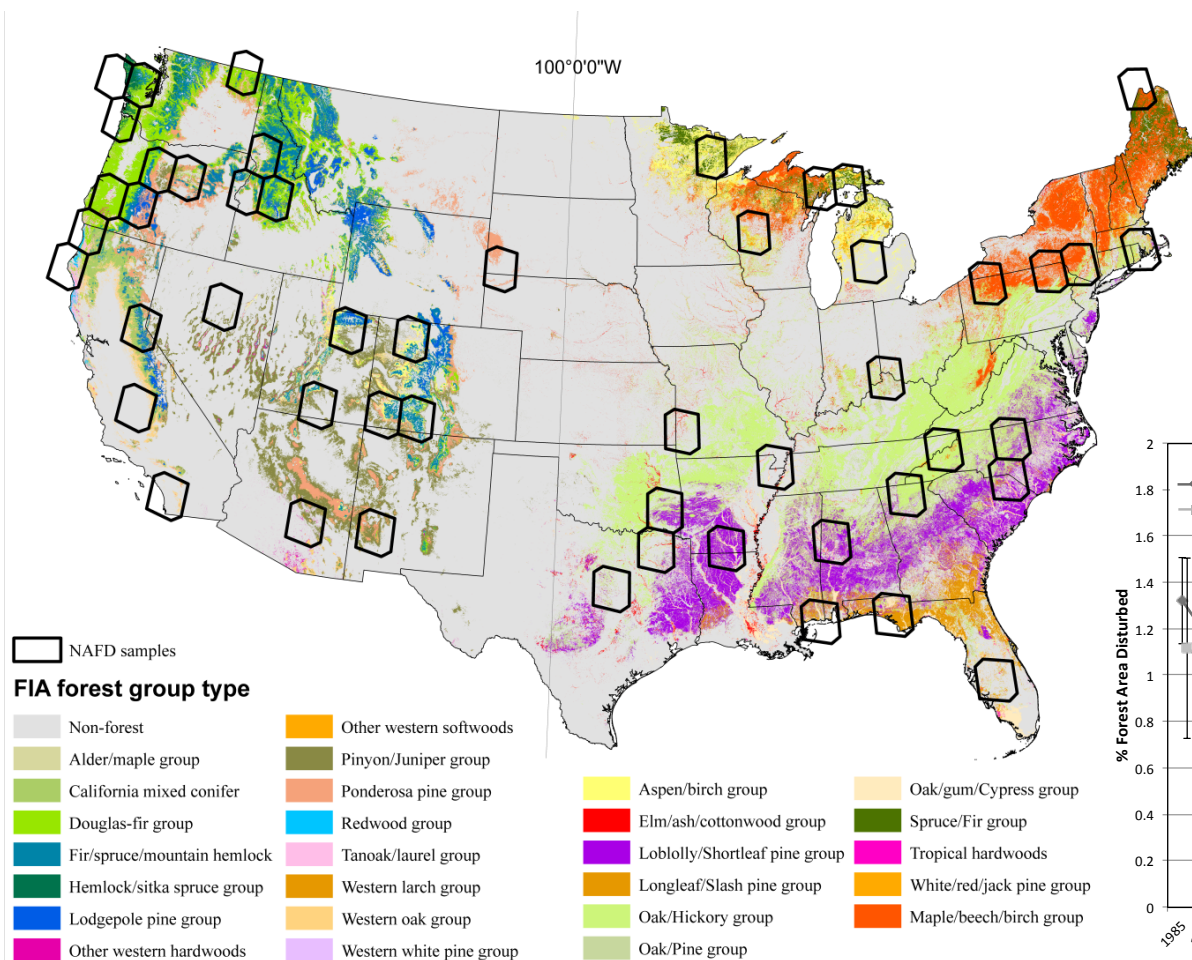


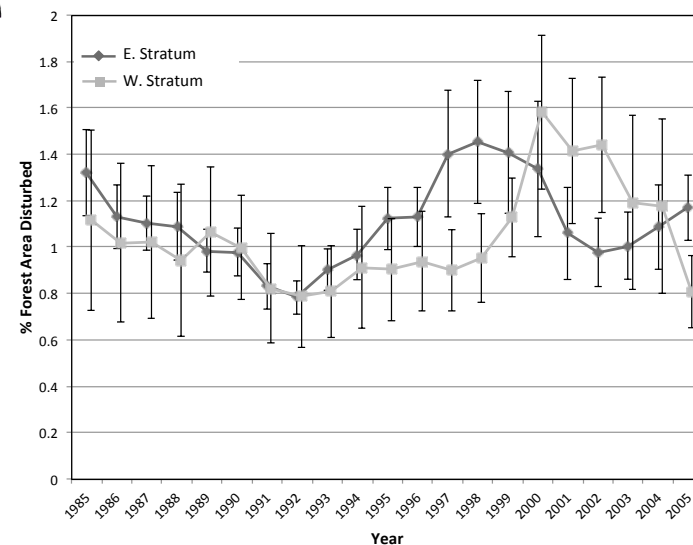


# First US Forest Disturbance Time Series from Landsat Analysis

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**Figure 1:** Locations of Landsat image time series overlaid on US forest types



**Figure 2:** Annual disturbance rates and sampling uncertainty for eastern and western US forests from NAFD analysis



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### **Abstract:**

Forest disturbance is a critical variable for assessing ecosystem carbon balance and structure. The North American Forest Dynamics Project (NAFD) has completed a statistical sample of US forest disturbance using 50 Landsat time series (1985-2005). The average rate of disturbance during 1985-2005 was 1.09% of US forestland. High western US disturbance rates were associated with active fire years and insect activity, while variability in the east is more strongly related to harvest rates in managed forests.

### **References:**

Masek, JG, Goward, SN., Kennedy, RE, Cohen, WB, Moisen, GG, Schleeuwies, K., Huang, C., United States forest disturbance trends observed using Landsat time series, in press *Ecology*, 2013.

**Data Sources:** The analysis was performed as part of the North American Forest Dynamics (NAFD) project, a NASA-funded investigation to improve characterization of US forest disturbance patterns in support of the North American Carbon Program (PI: Samuel Goward, University of Maryland; GSFC PI: Jeffrey Masek, Code 618 NASA GSFC). The analysis used 50 stacks of annual or semi-annual Landsat leaf-on imagery, selected using a probability-based sample design. Disturbance events at 30m resolution were identified using the Vegetation Change Tracker (VCT) algorithm (Huang et al., 2010, RSE) operating on per-pixel spectral time series. Disturbance type was not separated in this analysis.

### **Technical Description of Image:**

**Figure 1** (top), NAFD Landsat sample scenes (unique, non-overlapping scene areas) overlaid on the US Forest type map of Ruefenacht et al., 2008.

**Figure 2:** Disturbance rates and uncertainty estimates calculated separately for the eastern (dark grey) and western (light grey) strata. Error bars represent sampling error ( $\pm 1s$ ) and western points are offset by 0.2 years for clarity. Individual scene-based, per-year disturbance maps were aggregated to eastern and western per-stratum estimates using the probability of inclusion for each sample and the Horvitz-Thompson estimator for unequal-probability sample designs.

**Scientific significance:** Forest disturbance is a critical, but poorly quantified variable needed for parameterizing ecosystem carbon models, and plays a major role in controlling ecosystem structure and function. This is the first annual satellite-based estimate of national (eastern US, western US) forest disturbance rates for the 1980s-2000's. The time series reveals both the average rate of forest disturbance across the US (1.09% forest cover per year, or 2.77 Mha/yr) and the magnitude of interannual variability about that average rate. High western US disturbance rates were associated with active fire years and insect activity, while variability in the east is more strongly related to harvest rates in managed forests.

**Relevance for future science and relationship to Decadal Survey:** Current work is extending the NAFD study to map wall-to-wall forest dynamics using some 25,000 Landsat images and the NASA ARC NEX computing environment. The US Forest Service is beginning to incorporate Landsat-based techniques developed through NAFD and the earlier LEDAPS projects to map forest and land cover dynamics operationally across the United States. This type of information can also be incorporated with vegetation structure (radar or lidar) data sets to better understand forest carbon dynamics.